Docket No.: 141529.02/MSFT-2743
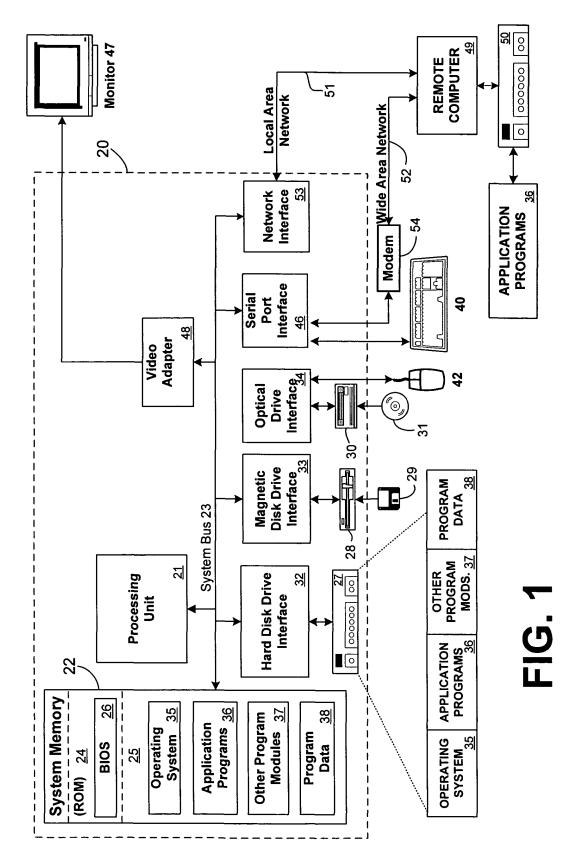App No.: Not yet assigned   Filed: Herewith
Title: Systems and Methods for Transforming Query Results into Hierarchical
        Information
Inventors: Michael Rys et al.
Attorney: Thomas E. Watson   Phone: (215) 568-3100
                        Sheet 1 of 10

FIG. 1

Docket No.: 141529.02/MSFT-2743
App No.: Not yet assigned   Filed: Herewith
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        Information
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                          Sheet 2 of 10

200

CLIENT 203 → QUERY → PARSER 205 → QUERY → QUERY PROCESSOR 207 → ROWSET → ROWSET TO HIERARCHY PROCESSOR 209

MODE INFORMATION

XML/HIERARCHICAL ROWSET

FIG. 2

Docket No.: 141529.02/MSFT-2743
App No.: Not yet assigned   Filed: Herewith
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        Information
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Attorney: Thomas E. Watson   Phone: (215) 568-3100
                        Sheet 3 of 10

209

ROWSET PROCESSOR

303

AUTO 1

309

Nested
Tree

305

AUTO 2

310

Nested
Tree

307

EXPLICIT

311

Universal
Table

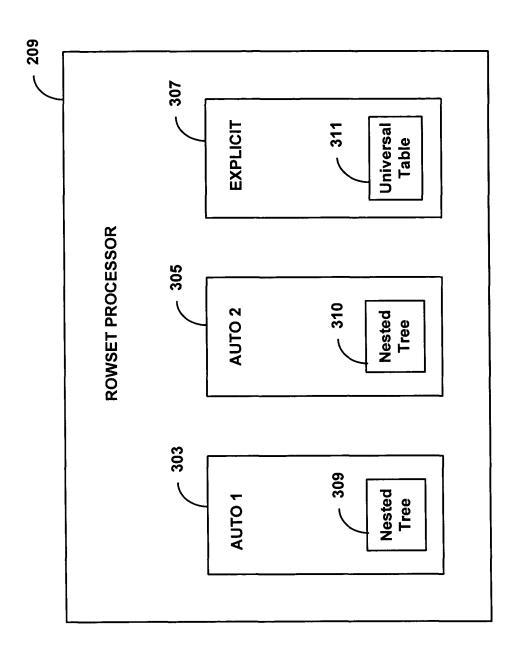FIG. 3

Docket No.: 141529.02/MSFT-2743
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                    Sheet 4 of 10

FIG. 4A

```
<Customer name="Smith">
      <Order oids="1397">
            <Orderdetail quantity="10"  product="ABC"  price="100"/>
            <Orderdetail quantity="5"  product="DEF"  price="50"/>
            <Orderdetail quantity="2"  product="GHI"/>
            <Employee id="987"/>
      </Order>
</Customer>
```

FIG. 4B

Docket No.: 141529.02/MSFT-2743
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        Information
Inventors: Michael Rys et al.
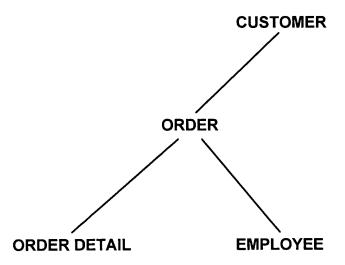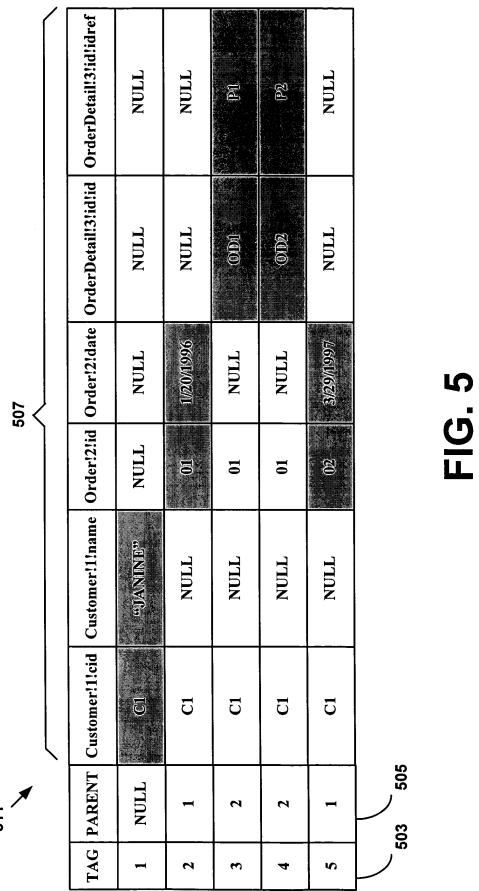Attorney: Thomas E. Watson   Phone: (215) 568-3100
Sheet 5 of 10

TAG	PARENT	Customer!1!cid	Customer!1!name	Order!2!id	Order!2!date	OrderDetail!3!id!id	OrderDetail!3!id!idref
1	NULL	C1	"JANINE"	NULL	NULL	NULL	NULL
2	1	C1	NULL	O1	1/20/1996	NULL	NULL
3	2	C1	NULL	O1	NULL	OD1	P1
4	2	C1	NULL	O1	NULL	OD2	P2
5	1	C1	NULL	O2	3/29/1997	NULL	NULL

FIG. 5

Docket No.: 141529.02/MSFT-2743
App No.: Not yet assigned   Filed: Herewith
Title: Systems and Methods for Transforming Query Results into Hierarchical
        Information
Inventors: Michael Rys et al.
Attorney: Thomas E. Watson   Phone: (215) 568-3100
Sheet 6 of 10

600a

XML(SELECT A.*,

    XML(SELECT B.* FROM B WHERE B.a=A.id, name="B"),

FROM A, name="A")

Results In

610a

```
<A>
    <id>1</id>
    <x>1</x>
    <B>
        <a>1</a>
        <y>2</y>
    </B>
    <B>
        <a>1</a>
    </B>



</A>
```

```
<A>
    <id>2</id>
    <B>
        <a>2</a>
        <y>1</y>
    </B>


</A>
<A>
    <id>3</id>
    <x>2</x>
</A>
```

Continued

FIG. 6A

Docket No.: 141529.02/MSFT-2743
App No.: Not yet assigned   Filed: Herewith
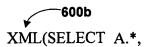Title: Systems and Methods for Transforming Query Results into Hierarchical
        Information
Inventors: Michael Rys et al.
Attorney: Thomas E. Watson   Phone: (215) 568-3100
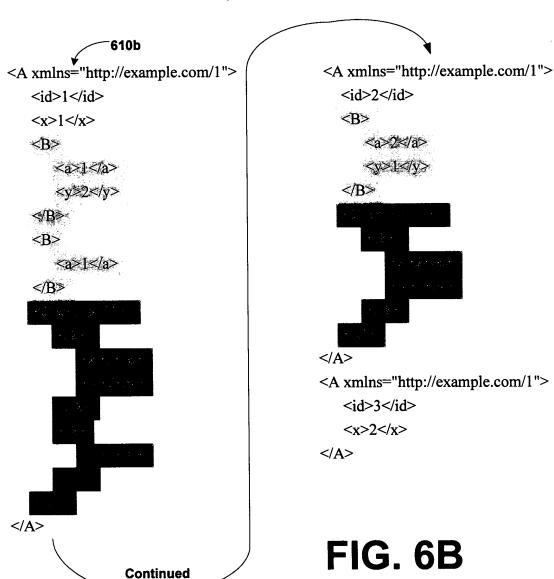   Sheet 7 of 10

600b

XML(SELECT A.*,

  XML(SELECT B.* FROM B WHERE B.a=A.id, name="B"),

▮▮

FROM A,

name="A", default namespace ="http://example.com/1")

Results In

610b

```
<A xmlns="http://example.com/1">
    <id>1</id>
    <x>1</x>
    <B>
        <a>1</a>
        <y>2</y>
    </B>
    <B>
        <a>1</a>
    </B>
    ▮▮▮▮▮▮▮▮
    ▮▮▮▮▮▮▮▮
    ▮▮▮▮▮▮▮▮
    ▮▮▮▮▮▮▮▮
</A>
```

Continued

```
<A xmlns="http://example.com/1">
    <id>2</id>
    <B>
        <a>2</a>
        <y>1</y>
    </B>
    ▮▮▮▮▮▮▮▮
    ▮▮▮▮▮▮▮▮
    ▮▮▮▮▮▮▮▮
</A>
<A xmlns="http://example.com/1">
    <id>3</id>
    <x>2</x>
</A>
```

FIG. 6B

Docket No.: 141529.02/MSFT-2743
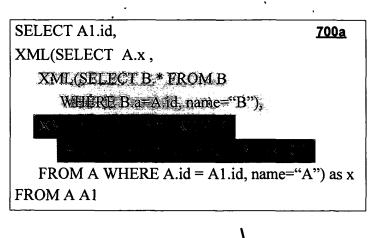App No.: Not yet assigned   Filed: Herewith
Title: Systems and Methods for Transforming Query Results into Hierarchical
        Information
Inventors: Michael Rys et al.
Attorney: Thomas E. Watson   Phone: (215) 568-3100
Sheet 8 of 10

700a

```
SELECT A1.id,
XML(SELECT  A.x ,
    XML(SELECT B.* FROM B
        WHERE B.a=A.id, name="B"),

    FROM A WHERE A.id = A1.id, name="A") as x
FROM A A1
```

**Resulting
Rowset**

FIG. 7A

710a

id	x

1	`<A>`
	  `<x>1</x>`
	  `<B>`
	    `<a>1</a>`
	    `<y>2</y>`
	  `</B>`
	  `<B>`
	    `<a>1</a>`
	  `</B>`
	  `</A>`

2	`<A>`
	  `<B>`
	    `<a>2</a>`
	    `<y>1</y>`
	  `</B>`
	  `</A>`

3	`<A>`
	  `<x>2</x>`
	  `</A>`

Docket No.: 141529.02/MSFT-2743
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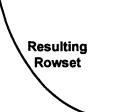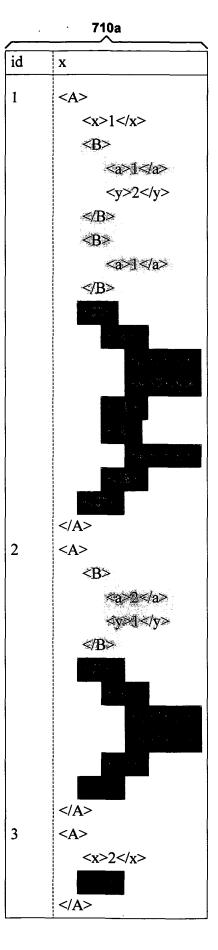   Sheet 9 of 10

A	**720a**
id	x
1	1
2	NULL
3	2

B	**720b**
a	y
1	2
1	5
1	1
2	1

```
SELECT A1.id,                                    700b
XML(SELECT  A.x ,
    XML(SELECT B.y as "@y" FROM B
        WHERE B.a=A.id ORDER BY B.y,
        name="B", map=path)
    FROM A WHERE A.id = A1.id, name="A") as x
FROM A A1
```

**Resulting
Rowset**

710b

id	x

1	`<A>`
	`   <x>1</x>`
	`   <B y ="1"/>`
	`   <B y ="2"/>`
	`   <B y ="5"/>`
	`</A>`

2	`<A>`
	`   <B y ="1"/>`
	`</A>`

3	`<A>`
	`   <x>2</x>`
	`</A>`

FIG. 7B

Docket No.: 141529.02/MSFT-2743
App No.: Not yet assigned   Filed: Herewith
Title: Systems and Methods for Transforming Query Results into Hierarchical
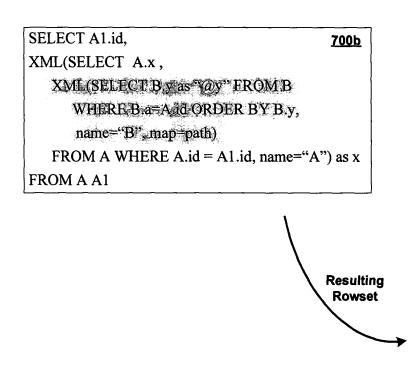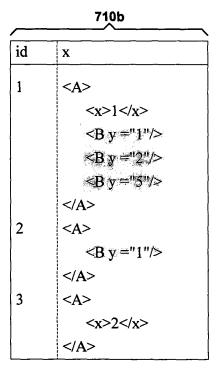   Information
Inventors: Michael Rys et al.
Attorney: Thomas E. Watson   Phone: (215) 568-3100
                        Sheet 10 of 10

A	**730a**
id	x
1	1
2	NULL
3	2

B	**730c**
a	y
1	'a'
1	'b'
1	'c'
2	'd'

```
SELECT A1.id,                                   700c
XML(SELECT
        CAST(
            XML(SELECT B.y || " " FROM B WHERE
                B.a=A.id ORDER BY B.y, name=" ")
            AS nvarchar(4000)) as "@by",
        A.x
    FROM A WHERE A.id = A1.id, map=path, name="A") as x
FROM A A1
```

Resulting Rowset

710c

id	x
1	<A @by="a b c" > <x>1</x> </A>
2	<A @by="d " />
3	<A> <x>2</x> </A>

FIG. 7C